# REPORT TO CONGRESS

# ON

# SEISMIC SAFETY

# PROPERTY STANDARDS

**AUGUST 1998**

**OFFICE OF HOUSING - FEDERAL HOUSING ADMINISTRATION**

**U. S DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT**

# EXECUTIVE SUMMARY

The Secretary of Housing and Urban Development is required by Section 947 of the 1990 National Affordable Housing Act (NAHA) (P.L 101425) to submit a biennial report to The Congress on the Department's activities regarding establishment of Seismic Safety Property Standards for properties assisted under HUD programs. In addition, the Report must contain information on a seismic risk assessment study conducted of all existing properties located in seismic risk zones. This third report covers the period from January 1995 through August 1998.

**Chapter I - Introduction** provides the background of legislation and Executive Orders concerning seismic safety for design and construction of buildings by the Federal Government, or leased, assisted or regulated by Federal agencies. Each agency is responsible for developing and implementing its own cost-effective seismic safety program commensurate with its specific program responsibilities. Also provided in this chapter is a brief summary of activities on seismic risk assessment, revision of HUD's design and construction standards, and relevant research., testing, and damage assessment projects.

**Chapter II - Seismic Risk Assessment Study** describes the approach being taken to evaluate the risk of earthquake damage to existing buildings constructed under HUD assistance programs. A status report on the Seismic Risk Assessment study conducted by the U.S. Geological Survey (USGS) under an Inter-Agency Agreement, is synopsized in this chapter.

**Chapter III - Standards Development** provides the background description of applicable standards which have been or are being revised to contain relevant seismic safety provisions to comply with executive and legislative mandates. This chapter presents accomplishments and necessary rule making procedures underway to meet implementation deadlines.

**Chapter IV - Summary** describes the activities undertaken to comply with Executive Order 12699 and Section 947 of 1990 NAHA, and total funds expended during the reporting period of January 1995 through August 1998.

# CHAPTER I

# INTRODUCTION

## General

Seismic hazards are a serious threat to both humans and their surroundings. These hazards exist in most of the United States, not just on the West Coast. Therefore, it is important in many areas of the Nation to design residential structures according to appropriate seismic standards in order to mitigate losses from earthquakes. The Federal Government, mandated by the Earthquake Hazards Reduction Act of 1977, developed the National Earthquake Hazards Reduction Program (NEHRP) to reduce the risks to life and property from future earthquakes.

On January 5, 1990, the President signed Executive Order 12699, Seismic Safety of Federal and Federally--Assisted or Regulated New Building Construction which calls for Federal agencies to use appropriate seismic design codes and standards for the design and construction of new buildings. To support the implementation of the Order, the Interagency Committee on Seismic Safety in Construction (ICSSC) recommended the use of seismic codes and standards that are substantially equivalent to the NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings. These provisions have now been incorporated in all national model building codes, and can be referenced by Federal agencies in regulations and standards for new construction.

One of the purposes of Executive Order 12699 is:

> to reduce risks to the lives of occupants of buildings leased for Federal uses or purchased or constructed with Federal assistance, to reduce risks to the lives of persons who would be affected by earthquake failures of federally assisted or regulated buildings, and to protect public investments, all in a cost-effective manner.

Each Federal agency is responsible for developing and implementing its own cost-effective, seismic safety programs commensurate with its mission and priorities. In addition, the Executive Order charges the ICSSC to use consensus procedures in recommending cost-effective standards. The Department has actively participated on ICSSC to identify and meet Departmental responsibilities under the Executive Order.

Coincident with Executive Order 12699, The National Earthquake Hazards Reduction Program (NEHRP) Reauthorization Act of 1990 was signed into law. The Act has provisions which will primarily impact on existing residential construction. The Act states: "The President shall adopt, not later than December 1, 1994, standards for assessing and enhancing the seismic safety of existing buildings constructed for or leased by the Federal Government which were designed and constructed without adequate seismic design and construction standards. Such standards shall be developed by the Interagency Committee on Seismic Safety in Construction (ICSSC). In addition, the President shall report to the Congress, not later than December 1. 1994, on how the standards could be applied to Federally-- assisted and regulated existing buildings."

The next relevant statute pertaining to seismic safety was Section 947 of the National Affordable Housing Act of 1990 [ P.L. 101-625; 104 Stat. 4416; 42 USC. 7704a]. In accordance with this section, the Department must conduct a seismic risk assessment of all existing properties assisted under programs administered by the Secretary, and develop seismic safety standards for new construction funded under HUD programs. In addition., the Secretary shall submit a biennial report to the Congress, containing a:

- Statement of findings of a risk assessment study, including risk assessment of properties located in seismic risk zones;

- Compilation of standards developed pursuant to Section 947;

- Statement of the activities undertaken by the Secretary to carry out Section 947; and amount and sources of any funds expended by the Secretary for such purposes; and

- Statement of activities undertaken by the Secretary to carry out requirements of Executive Order No. 12699; and amount and sources of any funds expended by the Secretary for such purposes.

This third Report to Congress on Seismic Safety Property Standards covers the period from January 1995 through August 1998.

**Seismic Risk Assessment of Existing Properties**:

Seismic risk assessment pertains to the evaluation of risk of earthquake damage to existing buildings constructed under HUD's assistance programs, as identified in Section 14.0 of the Catalog of Federal Domestic Assistance Programs. The terms "seismic risk" or "earthquake risk" are used in the engineering context to mean the likelihood of loss from probable earthquakes.

To satisfy the requirements of Section 947 of NAHA, an Inter-Agency Agreement (IAA) between HUD and the U.S. Geological Survey (USGS) was initiated in FY 1991. A second IAA was added in FY 1994 to conduct an earthquake risk assessment study. This continuing study includes three principal elements: 1) developing an inventory of buildings at risk (exposure - structures and people at risk); 2) determining vulnerability; and, 3) evaluating the potential earthquake hazard.

In order to develop an inventory of buildings at risk, field trips to San Francisco and Memphis were conducted by USGS personnel, to collect housing construction, geological/soil, and census tract data. Data has also been collected in Sacramento, San Diego, Phoenix, St. Louis, Salt Lake City, Seattle, Portland (OR), Columbia (SC), New York, and Boston. All inventory data is now being analyzed to assess vulnerability, earthquake risk, and potential losses from future probable earthquakes. A more thorough status report of this IAA will be described later in this report.

**Seismic Safety Standards:**

Regarding seismic safety standards, Executive Order 12699 charged the Interagency Committee on Seismic Safety in Construction (ICSSC) to use consensus procedures to develop cost-effective seismic design and construction standards for all Federal and Federally assisted or regulated new building construction. The ICSSC coordinated efforts of all Federal agencies to develop these seismic safety standards resulting in publication of ICSSC RP 2.1 (NIST 1992), Guidelines and Procedures for Implementation of the Executive Order on Seismic Safety of New Building Construction. Departmental representatives have actively participated in this activity.

Section 947 of NAHA (1990) assigned another related responsibility to the Secretary-- to develop seismic safety standards for existing properties assisted under HUD programs. The Secretary, however, is permitted to defer to local building codes that meet the seismic safety requirements established, and to utilize the resources of the National Earthquake Hazards Reduction Program (NEHRP). As required by NEHRP, the ICSSC developed standards for existing buildings, and published them as RP 4 (NISTIR 5382, Feb, 1994), Standards of Seismic Safety for existing Federally Owned or Leased Buildings.

All housing constructed under HUD mortgage insurance and low-rent public housing programs must meet the HUD-established Minimum Property Standards (MPS). The National Housing Act authorized the Secretary of HUD to prescribe these standards., and to establish requirements for insuring mortgages for single and multifamily residential structures, hospitals, and group facilities. Regulations for the MPS are contained in the Code of Federal Regulations at 24 CFR Part 200, Subpart S (starting at 200.925).

The HUD-MPS provides for seismic resistance by referencing the American Society of Civil Engineers (ASCE) Standard, ASCE 7-88 (originally issued as ANSI Standard A58.1-1982), Minimum Design Loads for Buildings and Other Structures. However, to comply with specific requirements of the Executive Order, on July 19, 1994 HUD published in the Federal Register (59 FR 36692) a Final Rule which amends the MPS to specify that effective August 18, 1994, seismic design is a mandatory standard for applicable housing.

Another affected HUD standard is the Federal Manufactured Home Construction and Safety Standards (24 CFR 3280) promulgated under a regulatory program mandated by the National Manufactured Housing Construction and Safety Standards Act of 1974. Therefore, under Executive Order 12699, since seismic standards are required to be promulgated for new construction regulated by Federal agencies, the Department is required to issue such standards. However, due to significant downsizing of technical staff at HUD, the Department has not yet been able to complete its responsibilities under the NAHA. To assist HUD in this endeavor, the National Fire Protection Agency (NFPA) has recently been selected by the Department to help HUD develop suggested changes to the Standards which are expected to include seismic design criteria for manufactured homes.

**Research and Testing Programs**:

The Department has undertaken extensive earthquake related research:

**Earthquake-Resistant Bracing Systems (ERBS) for Manufactured Housing:** HUD's Office of Policy Development and Research (PD&R) completed a contract with Steven Winter Associates and the National Conference on Building Codes and Standards (NCSBCS) to analyze the performance of ERBS for manufactured housing during the January 17, 1994 Northridge Earthquake. The project resulted in development of guidelines for retrofitting existing manufactured homes and installation criteria for new homes in seismically active areas.

**Damage Assessment/Studies after Northridge Earthquake:** Soon after the January 1994 Northridge earthquake, PD&R completed a series of damage assessments studies: (1) Performance of HUD - Assisted Properties during the January 17,1994 Earthquake by National Institute of Standards and Technology (NIST), Department of Commerce; (2) Assessment of Damage to Residential Buildings caused by the Northridge Earthquake by the National Association of Home Builders (NAHB), Research Center; and , (3) Preparing for the "Big One" --Saving Lives through Earthquake Mitigation in Los Angeles, California. In addition., the Office of Housing engaged the firm of Wiss, Janney, Elstner Associates and the National Conference of States on Building Codes and Standards (NCSBCS) to assess damage and determine causes of failures and fires in manufactured housing. Copies of reports of the above studies are available from **HUD USER** (Telephone: 1-800-245-2691, outside Maryland and District of Columbia, or (301) 519-5154).

# CHAPTER II

# SEISMIC RISK ASSESSMENT STUDY

## HUD-Assisted Construction

In accordance with Section 947 of the 1990 National Affordable Housing Act (NAHA), the Department must conduct a seismic risk assessment of all properties assisted under programs administered by the Secretary. This seismic risk assessment pertains to evaluation of risk of earthquake damage to existing buildings constructed under assistance programs (not all inclusive) identified in Section 14.0 of the Catalog of Federal Domestic Assistance Programs including:

**A** Formula Grants - Allocations of money to States in accordance with a distribution formula for activities of a continuing nature:

- Community Development Block Grants/Entitlements
- Rental Housing Rehabilitation
- Emergency Shelter Grants

**B** Project Grants - Funding of specific projects, including demonstration grants, construction grants, and contractual agreements:

- Nehemiah Housing Opportunity Grants
- Supportive Housing for Persons with Disabilities
- Indian and Small Cities Community Development Block Grants

**C** Direct Payments for Specified Use - Financial assistance provided directly to private firms or institutions to subsidize particular activities:

- Section 8, Moderate Rehabilitation
- Section 8, New Construction/Substantial Rehabilitation
- Supportive Housing Demonstration Program

**E** Direct Loans - Financial assistance provided through lending of Federal money with a reasonable expectation of repayment:

- Section 202, Housing for Elderly or Disabled
- Section 312, Rehabilitation Loans
- Supplemental Assistance for Facilities for Homeless

**F** Guaranteed/Insured Loans - Federal government indemnities lenders against part or all of any defaults by borrowers:

- Section 203(k), Rehabilitation Mortgage Insurance
- Construction or Substantial Rehab. of Condominiums
- Section 207, Mortgage Insurance - Rental Housing

## Preliminary Seismic Risk Assessment

In FY 1991, the Department initiated an Inter-Agency Agreement (IAA) with the U.S. Geological Survey (USGS) to conduct an Earthquake Risk Assessment for HUD Properties. From FY 1992 through FY 1994, Dr. E.V. Leyendecker of USGS conducted field trips to San Francisco, CA and Memphis, TN to evaluate inventory and report data available to evaluate earthquake risk. A Status Report, containing the following information, was submitted to HUD in January 1994:

### Introduction

Seismic risk assessments are complex and require integration of geological, seismological, engineering, sociological, and economic data. The term earthquake risk, in an engineering context, means the likelihood of loss. Evaluation of earthquake risk from a scientific and engineering perspective depends on three principle elements: 1) the earthquake hazard; 2) vulnerability; and 3) the inventory at risk (exposure of structures and people).

### Earthquake Hazard

Earthquake Hazard means the effects of earthquakes that may or may not result in economic or life loss or injuries.

Both deterministic (scenario) and probabilistic techniques are important in earthquake hazard assessment. In general, deterministic type hazard evaluations are more useful in estimating catastrophe potential than for estimating average annual loss. Often scenario hazard studies of the largest possible earthquake believed likely to occur are coupled with an evaluation of the probability of occurrence of such a large shock. Although deterministic evaluations of annual loss are difficult, they are possible if the seismicity of the area is sufficiently high and records are available for a reasonable span of time (around 200 years). An alternate technique for the estimation of both average annual loss and catastrophe potential is through probabilistic analysis of earthquake hazard and risk.

It is important to note that for HUD properties, the maximum hazard may not translate directly into the largest risk, since risk considers not only hazard, but also the inventory, and vulnerability of the inventory. For example, even in a moderate seismic

risk area, there may be a large inventory of relatively vulnerable buildings. This was one reason why Memphis was selected as the second location for study.

## Vulnerability

Vulnerability is the susceptibility of a structure or class of structures to damage, It is often expressed as the percentage of total replacement cost required for repairing or strengthening, when the structure is subjected to some specified type and severity of earthquake hazard. Vulnerability is the essential linkage between hazard and loss, and critical to risk assessment.

Unfortunately, the database for vulnerability is poor. There are a number of reasons for this: 1) characteristics of the building stock at risk change over the years as new buildings are built and older ones razed, 2) there is a problem with describing loss when older buildings are damaged or destroyed; how they should be repaired or be replaced, 3) damage information from many earthquakes is sketchy and only qualitative in nature; rarely presented in the context of total building stock at risk, and 4) post-earthquake damage surveys are expensive and time consuming.

Therefore, building classifications and accurate inventories need to be linked to vulnerability and earthquake hazard. In addition, damage/loss ratios are available which can be used to estimate vulnerability. However, a review of HUD files indicates that a breakdown of the data is not as refined as necessary for development of vulnerability curves. The best HUD data available only indicates wood, concrete, steel, or masonry construction. Height data and number of stories are not always available, so even a differentiation between low rise and high rise is not always possible.

In order to use available data, a range of percentage loss estimation will be determined, The preponderance of wood-framed construction reduces the number of estimates which need to be made. It also appears feasible to make reasonable estimates of structural systems based on construction dates and knowledge of what was being built at that time. When many projects are of unknown construction type, a judgment will be applied, based on factors, such as location, number of units, and mortgage value, to estimate construction type. The value of construction will also need to be updated from when the original data was entered to the present. Then, numbers will be estimated for values of properties with missing files, or estimates will be based on mortgage values.

## Inventory at Risk

The third and most difficult aspect of risk assessment is determination of a suitable inventory of buildings. The amount and detail of sampling possible in any particular risk assessment depend upon the amount of resources available for assessment. Three key ingredients, in addition to a building count, are: construction type, number of stories, and year of construction.

Examination of office files in San Francisco and Memphis HUD offices revealed that for recent projects detailed structural information could be attained from structural drawings. This included proper identification of all information required to classify building type, including the building code used for design. Unfortunately, for the majority of buildings, this information is not available, and there is no HUD-certified cost data.

The type of information readily available was a project listing prepared for management purposes, which included the following:

- Project Name and Address
- Project Number
- Section of Housing Act
- Mortgagor Address
- Management Agent
- Number of Units
- Mortgage Value
- Interest Rate

Although this data does not provide sufficient information to develop a seismic risk assessment inventory, it is a convenient source document, along with census tracts, to develop a representative list of buildings constructed under various HUD programs.

Another source of data is the Docket File for each project. Two FHA forms are usually present, and provide useful information on structural properties and costs Form 2264 - Project Income Analysis and Appraisal, and Form 2580 Maximum Allowable Mortgage. Identification of structural type was usually provided in general terms, such as wood, steel, concrete or masonry. Often, data on number of buildings or number of stories was missing for multiple buildings at a site, or a variable number of stories, data would not indicate the number of stories for each building.

In spite of the missing data, it is possible to develop a distribution of structural parameters, densities, and a summary of inventory information by census tract (rough estimates of numbers of units and mortgage value). From this data, census tracts with the largest inventory with the greatest probability of risk can be determined.

## Conclusion

Hazard maps, developed by USGS, will be used to estimate the degree of hazard. These maps, combined with population densities and aggregate dollar values of HUD-assisted properties, will be used to designate urban areas with the highest risk. There are also Geographic Information System (GIS) maps available with aggregate value of housing provided, which can be combined with soil, geological, and census data.

A Building Classification System is used to prepare a relative ranking of vulnerability by building type. This should provide the necessary vulnerability relationships for evaluating risk, if reliable inventories are developed. On-site investigations and inspections will also be needed to validate the inventories and augment the risk assessments.

Inventories and vulnerabilities can be developed commensurate with the accuracy of required assessments. Risk assessments can be undertaken at various levels of sophistication and to the desired level of accuracy; however, a comprehensive seismic risk assessment for the large inventory of HUD-assisted existing buildings vulnerable to probable high-intensity earthquakes will take continuous funding.

### Continued Seismic Risk Research

In 1994, an additional research proposal was funded by the Department's Office of Policy Development and Research (PD&R). This project with USGS is an expansion of the work conducted in San Francisco and Memphis in an effort to prepare an estimate of national risk of earthquake-related damage to properties assisted under HUD programs.

Based on the previous work, this study is utilizing existing data to arrive at a first order approximation of risk in various cities. It also appears feasible to obtain a preliminary national assessment of HUD exposure by collection of similar data from HUD regional offices. To accomplish this, three tasks are planned: (1) Expansion of building inventories (descriptions and costs), (2) Estimation of exposure by HUD regions, and (3) Determination of the range of loss estimates.

1. Expansion of Database: Ten additional cities were inventoried (Sacramento, San Diego, Phoenix, St. Louis, Salt Lake City, Seattle, Portland (OR), Columbia (SC), New York, and Boston). Sample inventories of 80 to 100 properties were compiled, incorporating data on geographical distribution, construction type, and hazard level.

2. Estimation of Exposure: Listings of all buildings and their mortgage values were obtained from each region. Data from a representative sample of buildings will be applied to the listings to estimate potential losses.

3. Determination of Range of Error: Estimates developed will be a first order approximation of losses. This is due in part to a lack of good inventories and cost

data. Therefore, it will be important to arrive at an estimate of the magnitude of error in the loss estimates.

After the January 1994, Northridge Earthquake, damage assessment surveys were conducted, including an assessment of building damage per building type. Using this survey data, two loss estimates are being prepared. One loss estimate used actual building type, the other assumed only a coarse classification of structural type. A comparison of these two loss estimates provide a limited idea of magnitude of error introduced by using the coarse classification of structural type. A second comparison will be made between actual losses for the actual inventory and the losses that would be predicted using the given inventory and an estimated hazard. This will provide a limited comparison between actual and predicted losses. A final report of this phase of development of a seismic risk assessment methodology is expected by the Fall of 1998.

Several developments have affected the direction of the project. One of these is the publication of new USGS maps of seismic hazard, including the capability of finding earthquake ground motion parameters by latitude-longitude and/or zip code using CD-ROM. A second is the release by FEMA and the National Institute of Building Science of the HAZUS earthquake loss estimation methodology. This new methodology includes procedures that define vulnerability of structures in terms of ground motion mapped by USGS instead of Modified Mercalli Intensity that has been used traditionally (and still is by many investigators). This new approach allows procedures used in the HAZUS methodology to be combined with the new USGS ground motion data to estimate losses.

The final loss model takes into account the way HUD collects property data. Since HUD property data are based primarily on street address and zip code location instead of census tract, the loss-estimation procedure will aggregate losses at the zip code level instead of the census tract level as originally planned. This will simplify use of the existing HUD data base in the loss-estimation procedure. Determination of hazard is made feasible since USGS data are now available by zip code.

# CHAPTER III

# STANDARDS DEVELOPMENT

## Revision to HUD Minimum Property Standards (MPS)

A Final Rule amending the seismic standards in the MPS was published in the Federal Register (59 FR 36692) on July 19, 1994, with an Effective Date of August 18, 1994. It amends the MPS in 24 CFR Part 200, Subpart S. to specify that seismic design is a mandatory standard for applicable housing. In addition, the rule adopts the American Society of Civil Engineers Standard ASCE 7-88, earthquake design requirements, as the mandatory standards. Similar standards were recently incorporated into all model building codes, including the Council of American Building Officials (CABO) - One and Two Family Dwelling Code, which HUD also adopts by reference. In order to ensure that these and other provisions of the MPS are adequately updated and maintained, the Department has recently entered into a contract with the National Evaluation Service (NES) to prepare recommendations for the Department which are expected to include updated seismic design criteria

These revisions help ensure the structural integrity of applicable housing, improve homeowner and occupant safety, reduce property loss, and protect the Department's insurance fund. In addition, the revised Minimum Property Standards enable compliance with the previously described Executive Order 12699, 1990 National Earthquake Hazards Reduction Program (NEHRP) Reauthorization Act, and Section 947 of the 1990 National Affordable Housing Act (NAHA).

## Revision to HUD Manufactured Housing Standards

The Manufactured Home Construction and Safety Standards (MHCSS, 24 CFR 3280) are promulgated as regulations in accordance with the National Manufactured Housing Construction and Safety Standards Act of 1974. Therefore, under Executive Order 12699, earthquake design and construction requirements for new manufactured housing construction should have been incorporated in the standards .However, due to continued downsizing in engineering staff which has occurred at HUD Headquarters, the Department was unable to proceed with development of a proposed rule for seismic safety in manufactured homes as previously reported

HUD recently announced the selection of the National Fire Protection Association (NFPA) to assist the Department in developing suggested changes to the Federal Manufactured Home Construction and Safety Standards which should also help

HUD fulfill its responsibilities under the NAHA. It is anticipated that as part of that process, the NFPA will suggest proposed standards for seismic design and construction requirements for the structure including connections between multiple section units, anchorage, foundation systems, protection of mechanical equipment and gas line supply connections, appurtenances, etc. for all manufactured homes designed to be located in earthquake prone areas.

**Proposed Part for Code of Federal Regulations (CFR)**

Separate regulations at 24 CFR Part 37 may be proposed to provide references to seismic design and construction provisions of the latest editions of the model building codes. This regulation could then be referenced in all respective Departmental program handbooks and regulations, including those for Public and Indian Housing, Community Planning and Development, and Housing programs. Each program office would then be able to review respective program regulations to determine applicability of earthquake standards for new construction.

**Seismic Safety Standards for Existing Buildings**

Existing In accordance with the Earthquake Hazards Reduction Act of 1977, as amended by P.L 101-614 in 1990, the Interagency Committee on Seismic Safety in Construction (ICSSC) developed and issued "Standards of Seismic Safety for Federally Owned or Leased Buildings" (ICSSC RP 4) in February 1994. On March 11, 1994, these standards were forwarded to Secretary Cisneros and the heads of over thirty other member agencies of the ICSSC. Finally, on December 1, 1994, President Clinton signed Executive Order 12941, "Seismic Safety of Existing Federally Owned or Leased Buildings."

This Executive Order requires all agencies who own or lease buildings to meet the new technical standards in any seismic evaluation or rehabilitation work which they undertake. Within four years of the signing of the E.0., each agency will also be required to develop seismic inventories of buildings and to estimate costs of mitigating unacceptable risks in those buildings.

As described in Chapter II, action is underway at USGS to develop a seismic risk assessment of all properties assisted under HUD programs. An integral part of this assessment is development of an inventory of buildings most at risk of damage or destruction from future earthquakes. Records have already been evaluated and information compiled of existing buildings in San Francisco and Memphis, TN. After the final seismic risk assessment methodology and inventories have been developed by USGS, appropriate strengthening and retrofitting of existing buildings to the ICSSC Standards can be planned and budgeted.

# CHAPTER IV

# SUMMARY

## Summary of Activities

As described in Chapters 11 and III of this Report, there have been a number of activities undertaken by the Department to comply with the reporting requirements of the National Affordable Housing Act of 1990, and Executive Order 12699:

- The Inter-Agency Agreement (1AA) with the U.S. Geological Survey (USGS), to develop a Seismic Risk Assessment Methodology and compile inventories of existing buildings at risk of damage or collapse from future earthquakes, continues. Preliminary reports were received on evaluations of seismic risk in San Francisco and Memphis. Data was collected on multi-family stock in Sacramento, San Diego, Phoenix, St. Louis, Salt Lake City, Seattle, Portland (OR), Columbia (SC), New York, and Boston.

- Revision of HUD's Minimum Property Standards (MPS) to contain mandatory seismic design and construction criteria was completed with publication of the revised standards in July 1994.

- The Department will be soliciting the assistance of NFPA to help develop proposed seismic requirements which can be added to the Manufactured Home Construction and Safety Standards.

## Amounts and Sources of Funds Expended

During the period of this report, Office of Policy Development and Research funds expended, exclusive of Departmental staffing time, consisted of $100,000 for continuation of the risk assessment and inventories by USGS; $68,000 with the University of Illinois for collecting inventory data for ten cities for the risk assessment study; $146,000 to conduct the study with Steven Winter Associates and the NCSBCS on the effect of earthquakes on manufactured home installations; $225,000 expended with the NIST on Performance of HUD-Assisted Properties During the January 17, 1994, Northridge Earthquake; and $126,000 with NAHB Research Center on Assessment of Damage of Buildings Caused by the Northridge Earthquake.